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The Oligocene Hsanda Gol Formation, Mongolia: A Revised Faunal List[1]

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INTRODUCTION

In 1922, the American Museum of Natural History Central Asiatic Expedition discovered a richly fossiliferous mid-Tertiary continental deposit in Mongolia. Berkey and Granger (1923) described the unit and named it the Hsanda Gol Formation, after a stream that has cut through a major portion of the section. The mammalian fossils were described in a series of preliminary papers by Matthew and Granger (1923a, 1923b, 1924a, 1924b). A later and much more extensive collection of fossil mammals was made in 1925, but much of that material lay uncatalogued and undescribed until I recently began a restudy of the fauna. The present paper is essentially a progress report on that work. In order to add some meaning to the faunal list, I have included notes on the geology and some general ideas about the paleoecology of the Hsanda Gol region.

I thank Dr. Malcolm C. McKenna for introducing me to the many problems represented in the Hsanda Gol fauna and also for his continual encouragement throughout the course of this study.

GENERAL GEOLOGY

The Hsanda Gol Formation is one of a series of rock units ranging

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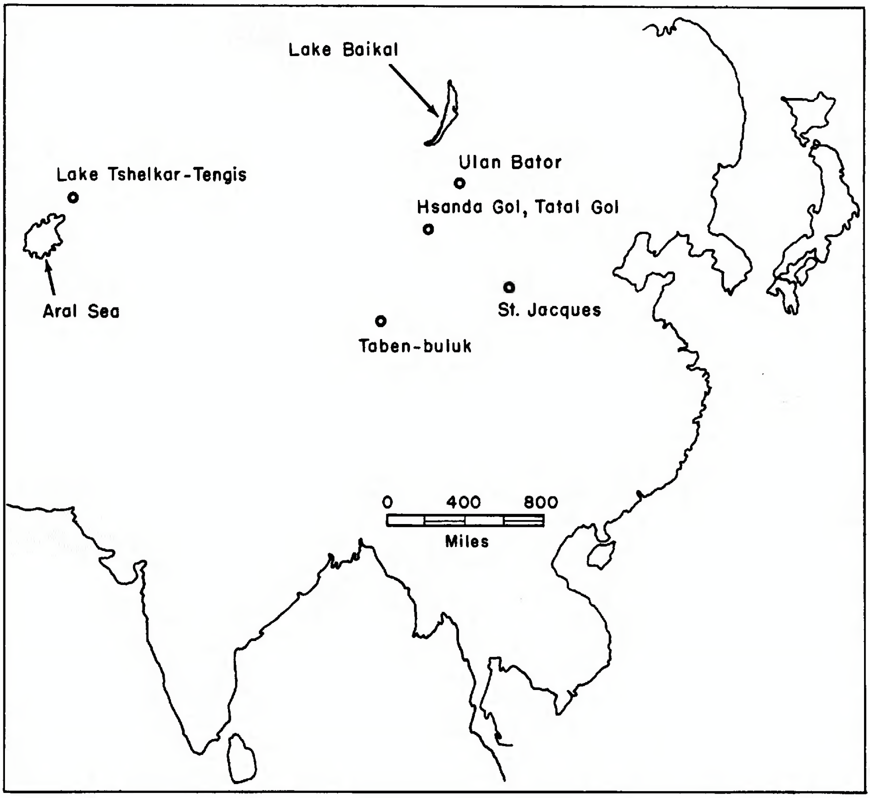

FIG. 1. Distribution of Oligocene fossil mammal localities mentioned in text.

in age from Cretaceous to Recent that was deposited in the Tsagan Nor[1] basin in central Mongolia (Mongolian People's Republic), about 300 miles southwest of the capital city of Ulan Bator (fig. 1). The basin is essentially a downfaulted block with an average surface elevation of 4000–5000 feet above sea level. It is bounded on the south by the Baga Bogdo Range (an eastward extension of the Altai Mountain system), which is composed of complex metamorphic and igneous rocks rising to an elevation of about 12,000 feet, and to the northwest by Uskuk Mountain. The latter, a rather complexly faulted horstlike structure, is also of a crystalline nature but rises only about 1000 feet above the level of the basin floor (fig. 2).

[1] Mongol for salt lake, a conspicuous feature in the area. Subject to fluctuations in extent, the lake is fed by a stream that rises about 75 miles to the north.

The formation is about 2600 feet thick and rests unconformably on the Cretaceous Ondai Sair Formation; it is conformably overlain in places by the variegated clays, sands, and gravels of the Loh Formation, judged to be Miocene in age by the occurrence of *Serridentinus,* a primitive proboscidean (Osborn, 1924).

Yellowish conglomerates predominate in the lower 400 feet of the Hsanda Gol Formation. Succeeding these are some 2000 feet of variegated (but mainly reddish) clays, silts, and sands. These are in turn overlain by 15 feet of tuff and a series of lava flows, 300 feet in thickness, which thin and pinch out to the south. A group of red silts, clays, and sands tops the basalt flows.

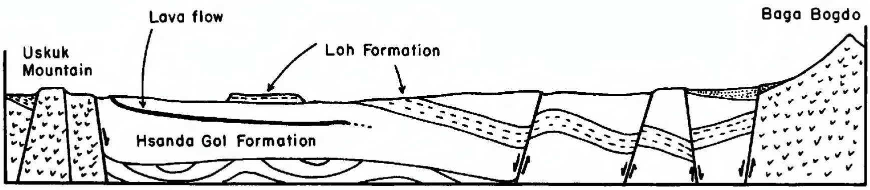

FIG. 2. Geologic cross section through the Tsagan Nor basin (adapted from Berkey and Morris, 1927). Length of section, about 40 miles.

According to field records, and a personal communication from K. Kowalski, mammals were found above and below the flows in the "Grand Canyon" area. As far as can be determined, they are part of the same fauna.

The fossils occur exclusively in a brick-red clayey silt. The matrix is usually friable, but local concentrations of silica or calcium carbonate have formed concretions of varying sizes in which some specimens were found. Most of the fossils are stained a deep black or are heavily mottled with dendrites of pyrolusite (a manganese oxide), apparently indicating their proximity to the lava flows. Cavities in the skulls and long bones of a few specimens are filled with calcite, gypsum, or both.

The age of the initial basin-forming deformation is reported as late Mesozoic, but tectonic activity in the area continued intermittently throughout the Tertiary and up into the Recent (Berkey and Morris, 1927; Solonenko, 1959),[1] supplying copious quantities of sedimentary fill. Most of the Hsanda Gol (and younger) sediments were probably derived from Baga Bogdo and neighboring mountains (possibly even

[1] The most recent movement along this fault zone resulted in an earthquake of catastrophic proportions on December 4, 1957.

the Khanghai Range farther north), because Uskuk Mountain is capped by basalts and sediments similar to those of the Hsanda Gol beds and is unlikely to have supplied clastics during Hsanda Gol time.

LOCALITIES

Most of the Hsanda Gol fossils were collected at two localities: the Loh campsite and the "Grand Canyon" area, which is 10 miles west of Loh. A number of other collecting sites exist but, with one exception (field no. 548), are within a 15-mile radius of the Loh camp.

With the exception of a sifting operation involved in the collection of bone fragments of a giant rhinoceros (Andrews, 1932, p. 143), all the fossils were collected by surface prospecting. Their abundance stirred Andrews (*op. cit.,* p. 106) to remark: "Over the red and brown buttes and hillocks, thousands of rodent jaws and skulls had weathered out. In places it seemed as though they had been sown like grain with a lavish hand." As is usual in badlands areas, the fossils are concentrated on the surface as a lag deposit left behind by subaqueous and subaerial erosion of the finer-grained particles.

A complete list of localities visited by American Museum of Natural History personnel during the Central Asiatic Expeditions of 1922 and 1925 into the Tsagan Nor basin follows.[1] Field numbers represent daily collections and do not necessarily indicate different localities. For example, specimens bearing field numbers 531, 532, and 533 (which comprise fully one-third of the total collection) were all taken from the same site on three consecutive days.

All data are from the field books of the Central Asiatic Expeditions of 1922 and 1925 (Granger, MS).

Hsanda Gol Locality	Field Numbers
Loh	49, 51, 54, 55, 56, 58, 59, 60, 65, 68, 69, 72, 75, 77, 80, 81, 83, 84, 85, 538, 539, 540
"Grand Canyon"	66, 70, 73, 74, 93, 531, 532, 533, 534, 535
12 miles east of Loh	57
15 miles east of Loh	78
5 miles northeast of Loh	88
2 miles southwest of Loh	87, 89, 90, 91, 92
2 miles west of "Grand Canyon"	536, 537
15 miles northeast of Kholobolchi Nor[2]	548

[1] Specimens carrying numbers 49 through 93 were collected in 1922; those bearing numbers 531 through 548 were obtained in 1925.

[2] Kholobolchi Nor is an intermittent lake lying about 100 miles northwest of Tsagan Nor.

AGE AND CORRELATION OF THE HSANDA GOL FORMATION

The first paper on the Hsanda Gol Formation (Berkey and Granger, 1923) contained a brief description of the type section and a suggestion that the beds were Miocene in age. Later, Matthew and Granger (1923a, 1924b) corrected the latter and claimed that the beds were probably deposited during the early Oligocene. Other estimates have ranged from the middle Oligocene (e.g., Shevyreva, 1965) to the upper Oligocene (Simpson, 1947) or Aquitanian[1] (Teilhard and Leroy, 1942). Part of the difficulty in assigning an age to the sediments is an intrinsic one arising from the endemic nature of the mammal fauna, but an extrinsic difficulty results from an attempt to fit rock formations and associated faunas into equal tripartite divisions of Tertiary epochs and at the same time relate the formations to European and North American Land-Mammal Ages.

The latter difficulty cannot be resolved here, nor can it be avoided if meaningful statements are to be made about the age of the Hsanda Gol fauna.

The accompanying chart (fig. 3) represents an attempt to correlate the Hsanda Gol mammal fauna with North American and European Land-Mammal Ages with the use of the method of overlapping or concurrent range zones, based on genera (or probable genera) the ranges of which in North America and Europe are reasonably well known. The range data were taken mainly from Simpson (1945). I have assumed that his usage of "lower," "middle," and "upper" in that paper correspond to his later usage (Simpson, 1947) of these terms as equivalents of North American and European Land-Mammal Ages. The outline for the chart is based on figure 1 in Evernden and others (1964); North American and European ranges are combined.

The ranges of all nine genera would be concurrent at about the Chadronian-Orellan or Sannoisian-Rupelian boundary. This estimate of the age (based on faunal evidence) is fully consistent with a potassium-argon radiometric date obtained on a sample of the Hsanda Gol lava[2] ($31-32 \times 10^6$ years ago; Evernden and others, 1964, p. 193). Because usage of the Land-Mammal Ages given above would be cumbersome, for the sake of brevity I have used the expression "middle Oli-

[1] Referred by various authors to either the upper Oligocene or the lower Miocene. This is a problem in itself.

[2] Which is bracketed by sediments bearing the same mammal fauna (Granger, MS, and K. Kowalski, personal communication).

TABLE 1
DISTRIBUTION OF HSANDA GOL MAMMALS BY LOCALITY

	2 Miles West of "Grand Canyon"	2 Miles Southwest of Loh	12 Miles East of Loh	15 Miles East of Loh	5 Miles Northeast of Loh[a]	15 Miles Northeast of Kholobolchi Nor	Loh (Excluding Field No. 538)	"Grand Canyon" (Tatal Gol)	Field No. 538
Palaeoscaptor acridens	—	—	—	—	—	x	x	—	x
Amphechinus rectus	—	—	—	—	—	—	x	—	—
Exallerix hsandagolensis	—	—	—	—	—	—	—	?	—
Tupaiodon morrisi	—	—	—	—	—	—	x	—	—
?*T. minutus*	—	—	—	—	—	—	x	—	—
Desmatolagus gobiensis	—	x	—	x	—	—	x	x	x
"*D.*" *robustus*	—	—	—	x	—	x	x	x	x
?*Gobiolagus teilhardi*	—	—	—	—	—	—	—	x	—
Sinolagomys tatalgolicus	—	—	—	—	—	—	—	x	—
Ochotonolagus argyropuloi	—	—	—	—	—	—	—	x	—
Procaprolagus vetustus	—	—	—	—	—	—	—	x	—
P. mongolicus	—	—	—	—	—	—	—	x	—
P. orlovi	—	—	—	—	—	—	—	x	—
P. maximus	—	—	—	—	—	—	—	x	—
P. youngi	—	—	—	—	—	—	—	x	—
?*Plesispermophilus lohiculus*	—	—	—	—	—	—	—	x	—
Prosciurus sp.	—	—	—	—	—	—	—	x	—
Pseudocylindrodon sp.	—	—	—	—	—	—	—	x	—
Tsaganomys altaicus	x	—	x	x	—	x	x	x	x
Cyclomylus lohensis	—	—	—	—	—	—	x	x	x
Selenomys mimicus	—	x	x	x	—	—	x	x	—
Cricetops d. dormitor	—	x	x	x	—	x	x	x	x
C. d. elephantus	—	x	x	—	—	—	x	x	x
Eumys asiaticus	—	—	—	x	—	—	x	x	x
Tachyoryctoides obrutschewi	x	—	—	—	—	—	—	—	—
T. pachygnathus	x	—	—	—	—	—	—	—	—
Tataromys sigmodon	—	—	—	—	—	—	x	—	—
T. plicidens	—	—	—	—	—	x	x	x	x
T. deflexus	x	—	—	—	—	—	—	x	—
Karakoromys decessus	—	x	—	—	—	—	x	x	—
?*Leptotataromys*	—	—	—	—	—	—	x	x	—

TABLE 1—(Continued)

	2 Miles West of "Grand Canyon"	2 Miles Southwest of Loh	12 Miles East of Loh	15 Miles East of Loh	5 Miles Northeast of Loh	15 Miles Northeast of Kholobolchi Nor	Loh (Excluding Field No. 538)	"Grand Canyon" (Tatal Gol)	Field No. 538
Didymoconus colgatei	—	—	—	—	—	—	x	x	x
D. berkeyi	x	—	—	—	—	—	x	x	—
Hyaenodon pervagus	x	x	—	—	—	x	x	x	x
H. aymardi	—	—	—	—	—	—	—	x	—
H. ambiguus	—	—	—	—	—	—	—	x	—
H. compressus	—	—	—	—	—	—	—	x	—
Amphicticeps shackelfordi	—	x	—	—	—	—	x	—	—
?*Cynodictis constans*	—	—	—	—	—	—	x	—	—
Amphicynodon teilhardi	—	—	—	—	—	—	x	—	—
Palaeogale spp.	—	—	x	x	—	—	x	x	x
Cf. *Plesictis*	—	—	—	—	—	—	—	x	—
Palaeoprionodon gracilis	—	x	—	—	—	—	—	—	—
Nimravus spp.	—	—	—	—	—	—	—	x	—
Indricotherium grangeri	—	x	—	—	—	—	x	x	—
Eumeryx culminis	—	x	x	x	—	—	x	x	x
Pseudomeryx gobiensis	—	—	—	—	—	—	—	x	—
Palaeohypsodontus asiaticus	—	—	—	—	—	—	—	x	—

[a] No specimens were found in the collections.

gocene" in describing the temporal distribution of Hsanda Gol mammals.[1]

A comparison of the Hsanda Gol mammal fauna with faunas from other Asian localities reveals some striking similarities, but also some obvious differences that are temporal, ecological, or both. In general, the Hsanda Gol fauna is "balanced" (herbivores more abundant than

[1] It must be emphasized here that my use of this expression is not the exact equivalent to that of most other authors (i.e., as Orellan or Rupelian); in terms of "absolute age," the Hsanda Gol beds fall at about the middle of the Oligocene.

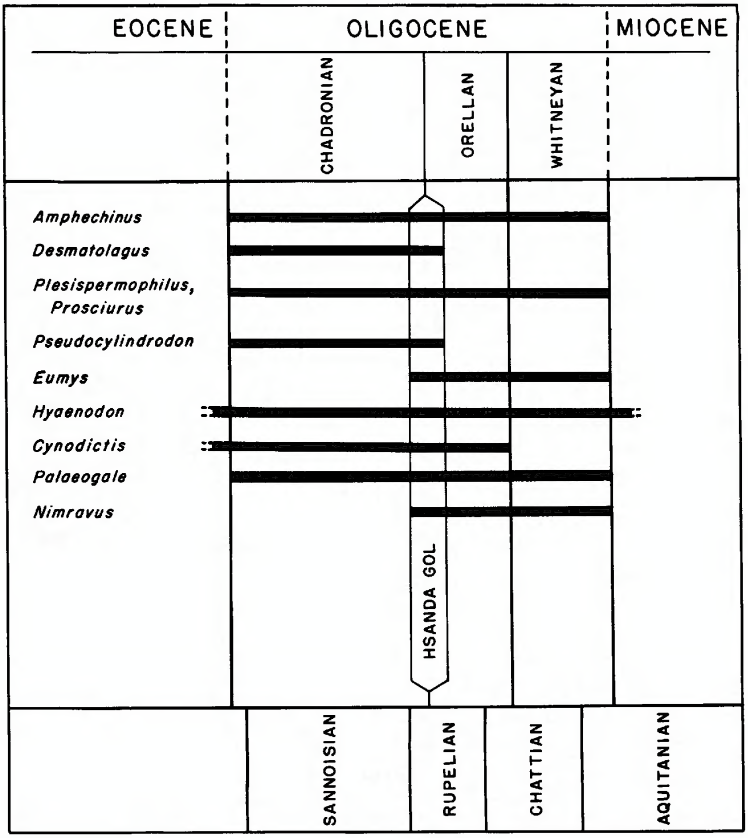

FIG. 3. Age and correlation of the Hsanda Gol Formation based on concurrent range zones of nine mammalian genera.

carnivores) and quite diverse, but rather less diverse than a fauna found in Kazakhstan. With the exception of ctenodactyloid rodents and some lagomorphs and insectivores, all the Hsanda Gol genera (and most species) occur in Kazakhstan also, suggesting that a close time equivalence exists between the two areas. The beds in Kazakhstan, however, contain an enormous variety of perissodactyls (tapiroids, diverse rhinocerotids, equids, chalicotheres) and artiodactyls (entelodonts, anthracotheres, suids, many tragulids) which are not found in the Hsanda Gol region. An ecological difference presumably existed between the two areas; most of the Kazakhstanian ungulates were apparently browsing, forest-dwelling forms and indicate that the climate in this area was much wetter than the co-latitudinal Hsanda Gol region.

At least three stratigraphic levels are represented in the Oligocene

beds at Kazakhstan, and an equivalent series probably also occur at Hsanda Gol. For example, *Tachyoryctoides* (=*Aralomys*) occurs in the uppermost Oligocene strata in Kazakhstan; this genus is also found in Hsanda Gol, but at a locality (field number 536) distinct from (apparently younger than) localities that yielded the bulk of the Hsanda Gol fauna.

Mammal faunas described by Bohlin (1937, 1942, 1946) and Teilhard (1926) from Kansu and Ordos, respectively, are similar to the Hsanda Gol fauna, but are somewhat sparser and probably younger. The reasons for suggesting a temporal difference are as follows: *Tachyoryctoides obrutschewi* occurs in Kazakhstan in beds stratigraphically above (younger than) the layers that carry a fauna equivalent to the Hsanda Gol; this species appears at Hsanda Gol in beds that yielded *Tataromys deflexus. Tataromys deflexus* occurs at St. Jacques (Ordos), and *Tataromys* cf. *deflexus* and *Tachyoryctoides obrutschewi* appear at Taben-Buluk (Kansu). Teilhard (1926) also reported a proboscidean from St. Jacques, but that this form (suggesting a Miocene age) occurred in the same layers as the remainder of the St. Jacques fauna is not at all certain.

I cannot exclude the possibility that a facies difference exists between the Chinese localities and Hsanda Gol, because the former lie south of Hsanda Gol, where a wetter climate may have prevailed. The occurrence of fish, crocodiles, and chalicotheres at St. Jacques supports the latter suggestion, but at the same time does not necessarily exclude the likelihood of a temporal difference.

HSANDA GOL FAUNAL LIST

Included in this list are all vertebrates reported as occurring in the Hsanda Gol Formation.

For a comparison of the Hsanda Gol mammal fauna with faunas from other Asian localities, see papers by Belyaeva, 1964 (Soviet Union), Bohlin, 1937, 1942, 1946 (Kansu), and Teilhard, 1926 (Ordos). Other localities bearing Oligocene mammal faunas have been reported in the southern Gobi (Kielan-Jaworowska and Kowalski, 1965, and K. Kowalski, personal communication) and will be described at some future date.

Class Amphibia
- Family Pelobatidae
  - *Macropelobates osborni* Noble, 1924

Class Reptilia
- Order Chelonia
  - Genus and sp. indet.

Order Squamata
Crythiosaurus mongoliensis Gilmore, 1943
Class Mammalia
Order Insectivora
Family Erinaceidae
Palaeoscaptor acridens Matthew and Granger, 1924
Amphechinus rectus (Matthew and Granger, 1924)
Tupaiodon morrisi Matthew and Granger, 1924
?Tupaiodon minutus Matthew and Granger, 1924
Exallerix hsandagolensis McKenna and Holton, 1967
Order Lagomorpha
Family Lagomyidae
Sinolagomys tatalgolicus Gureev, 1960
Ochotonolagus argyropuloi Gureev, 1960
Desmatolagus gobiensis Matthew and Granger, 1923
"Desmatolagus" robustus Matthew and Granger, 1923
Family Leporidae
?Gobiolagus teilhardi Burke, 1941
Procaprolagus vetustus (Burke, 1941)
Procaprolagus mongolicus Gureev, 1960
Procaprolagus orlovi Gureev, 1960
Procaprolagus maximus Gureev, 1960
Agispelagus simplex Argyropulo, 1940
Agispelagus youngi Gureev, 1960
Order Rodentia
Family Paramyidae
?Plesispermophilus lohiculus (Matthew and Granger, 1923)
Prosciurus Matthew, 1903, cf. *Prosciurus* sp.
Family Cylindrodontidae
Pseudocylindrodon Burke, 1935, cf. *Pseudocylindrodon* sp.
Tsaganomys altaicus Matthew and Granger, 1923
Cyclomylus (="*Pseudotsaganomys*") *lohensis* Matthew and Granger, 1923
Family ?Aplodontidae
Selenomys mimicus Matthew and Granger, 1923
Family Cricetidae
Cricetops dormitor dormitor Matthew and Granger, 1923
Cricetops dormitor elephantus Shevyreva, 1965
Eumys asiaticus Matthew and Granger, 1923
Family Rhizomyidae
Tachyoryctoides (= "*Aralomys*") *obrutschewi* Bohlin, 1937
Tachyoryctoides pachygnathus Bohlin, 1937
Family Ctenodactylidae
Tataromys sigmodon Matthew and Granger, 1923
Tataromys plicidens Matthew and Grander, 1923
Tataromys deflexus Teilhard, 1926
Karakoromys decessus Matthew and Granger, 1923
Karakoromys (? = *Leptotataromys*), cf. *Karakoromys* sp.
Order Deltatheridia
Family Didymoconidae

Didymoconus (="*Tshelkaria*") *colgatei* Matthew and Granger, 1924
Didymoconus berkeyi Matthew and Granger, 1924
Family Hyaenodontidae
Hyaenodon pervagus Matthew and Granger, 1924
Hyaenodon aymardi Filhol, 1881
Hyaenodon ambiguus Martin, 1906
Hyaenodon compressus Filhol, 1876
Order Carnivora
Family Miacidae
Amphicticeps shackelfordi Matthew and Granger, 1924
Family Canidae
?*Cynodictis elegans* Matthew and Granger, 1924
?*Cynodictis constans* (Matthew and Granger, 1924)
Amphicynodon teilhardi (Matthew and Granger, 1924)
Family Mustelidae
Palaeogale (="*Bunaelurus*") *ulysses* Matthew and Granger, 1924
Palaeogale parvula Matthew and Granger, 1924
Plesictis Pomel, 1846, cf. *Plesictis* sp.
Family Viverridae
Palaeoprionodon gracilis Matthew and Granger, 1924
Family Felidae
Nimravus Cope, 1879, cf. *Nimravus* sp.
Proailurus Filhol, 1879, cf. *Proailurus* sp.
Order Perissodactyla
Family Hyracodontidae (including Indricotheriidae; see Radinsky, 1967)
Indricotherium (=*Baluchitherium*) *grangeri* Osborn, 1923
Family Rhinocerotidae
Gen. and sp. indet.
Order Artiodactyla
Family Cervidae
Eumeryx culminis Matthew and Granger, 1924
Miomeryx Matthew and Granger, 1925, cf. *Miomeryx* sp.
Family Gelocidae
Pseudomeryx gobiensis Trofimov, 1957
Family Bovidae
Palaeohypsodontus asiaticus Trofimov, 1958

REMARKS ON PALEOECOLOGY

The great abundance of rodents and the absence of many large herbivores suggest that the Hsanda Gol area during the Oligocene was probably open country and not forested, although gallery forests may have prevailed along water courses. Whether the open areas were grassy or shrub-covered is not certain.

The spadefoot toad *Macropelobates* appeared to demand a somewhat wetter climate in the Tsagan Nor basin during the middle Oligocene than now prevails there, although that form could have been eliminated

at any time after the Oligocene by any number of factors, of which rainfall is just one.

The presence of the insectivores *Amphechinus, Palaeoscaptor, Exallerix,* and *Tupaiodon* does not yield definitive information about the Hsanda Gol climate, because they are representatives of a family that occurs today under a number of different ecological situations. The same is also true for the lagomorphs in the fauna, although the relative abundance of these forms suggests that they inhabited rather open country.

It is the rodents, however, that give the most information about Hsanda Gol environmental conditions. They are by far the most abun-

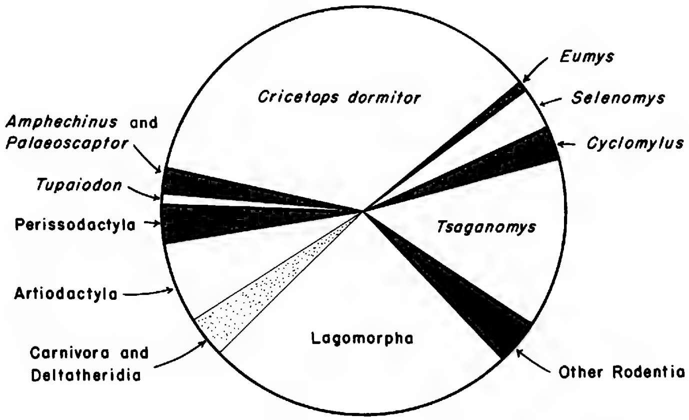

FIG. 4. Relative abundance of Hsanda Gol mammals based on numbers of jaws and teeth; $N=3300$ specimens, approximately.

dant herbivores in the fauna (fig. 4) and for the most part belong to groups that today are fossorial or occur in semi-arid regions, or both. *Tsaganomys* and *Cyclomylus,* if not true bathyergids, were certainly bathyergid-like in their habits. The Bathyergidae today typically occur in sandy soil in arid areas (Walker, 1964, p. 1071). *Selenomys* is most likely a member of the fossorial Aplodontidae. *Cricetops* and *Eumys* are members of the cricetine cricetids, a widespread, diverse group containing some members that inhabit semi-arid to arid regions. *Tachyoryctoides* is a representative of the fossorial and (usually) open-plains-dwelling Rhizomyidae. Finally, the Hsanda Gol ctenodactyloids (*Tataromys, Karakoromys,* and *Leptotataromys*) have living relatives that today inhabit arid, rocky regions of northern Africa (Walker, 1964, p. 1078).

Hyaenodon probably occurred in a variety of Holarctic habitats in the mid-Tertiary, and its presence in Hsanda Gol is probably not indicative

TABLE 2

COMPARISON OF THE PRESENT MAMMAL FAUNA OF THE NORTHERN GOBI WITH THAT OF HSANDA GOL TIME

Present Today	Presumed Oligocene Equivalent
Erinaceus auritus	*Palaeoscaptor, Amphechinus*
Crocidura leucodon	*Tupaiodon*
Plecotus auritus	—
Vespertilio savii	—
Vormela peregusna	*Palaeogale*
Mustela nivalis	*Palaeogale*
Martes foina	*Amphicticeps*
Gulo gulo	Cf. *Plesictis*
Ursus pruinosus	—
Vulpes vulpes	*Cynodictis*
Canis lupus	*Hyaenodon*
Felis uncia	*Proailurus*
Felis lybica	*Nimravus,* small sp.
Lynx lynx	*Nimravus,* large sp.
Equus hemionus	Small rhinocerotids
Equus przewalski	Small rhinocerotids
Camelus bactrianus	*Indricotherium*
Gazella subgutturosa	*Eumeryx*
Capra sibirica *Ovis ammon*	Other artiodactyls
Sus scrofa	—
Lepus tibetanus	*"Desmatolagus" robustus*
Ochotona daurica	*Ochotonolagus*
Ochotona pallasii	*Desmatolagus gobiensis*
Marmota sibirica	*Cyclomylus*
Salpingotus kozlovi	*Karakoromys*
Allactaga bullata	*Selenomys*
Allactaga saltator	*Selenomys*
Mus musculus	*Eumys*
Cricetulus migratorius	*Cricetops*
Rhombomys opimus	*Cricetops*
Meriones meridianus	*Cricetops*
Ellobius talpinus	*Cricetops*
Alticola argentatus	*Cricetops*

of any particular type of climate. The odd inflation of the mastoid region in *Didymoconus,* however, seems to indicate that the conditions under which it lived were probably semi-arid to arid. Forms with similarly inflated ear regions (*Dipodomys, Macroscelides*) characteristically occur in semi-arid areas.

No single carnivore genus in the fauna appears to be diagnostic of a particular climatic regime.

Indricotherium could have had a giraffe-like ecology, but if the suggestions of Granger and Gregory (1936) on its mode of feeding are correct, the genus could have been the ecological equivalent of a present-day camel.

The artiodactyls are important phylogenetically, but, with the exception of the hypsodont *Palaeohypsodontus* [which, according to Trofimov (1958), may indicate the existence of grasses at Hsanda Gol] do not bear on climate in any way.

The presence at Hsanda Gol of large mammal bones that have been gnawed by rodents is consistent with an interpretation of a rather open, dry plains environment. It is interesting to note here that bones with similar rodent incisor marks also occur in the North American White River Oligocene (Scott and Jepsen, 1936).

Although negative evidence should not be relied upon very heavily, a number of groups of mammals do not occur at Hsanda Gol, and their absence has some bearing on the climate of the area. The absence of primates suggests that the climate was not tropical and, possibly as a corollary, that tree cover was not continuous. The Hsanda Gol area also contains an impoverished sample of the enormously diverse perissodactyls and artiodactyls that were abundant in other Holarctic regions in the mid-Oligocene. It is significant that these forms (equids, chalicotheres, various rhinoceroses, anthracotheres, entelodonts, many tragulids) are mainly browsing types that probably could not enter the semi-arid Hsanda Gol region.

An interesting comparison (table 2) can be drawn between the Oligocene fauna of the Tsagan Nor basin and the present fauna inhabiting that region (data from Dementiev, 1963). Some members of the Recent fauna lack ecological equivalents in the Hsanda Gol fauna (e.g., *Ursus, Sus,* and the Chiroptera), and *Didymoconus* and *Exallerix* are without Recent ecological equivalents. The agreement between the two faunas is otherwise quite good, indicating that climatic and ecological conditions in the Tsagan Nor basin in the mid-Oligocene probably did not differ appreciably from conditions that prevail today.

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